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Sea-level and climatic controls on Aptian depositional environments of the Eastern Russian Platform

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ABSTRACT

On the basis of a high-resolution chronostratigraphic framework of the Eastern Russian Platform, a comparison between Late Barremian–Aptian global and regional sea-level trends was performed. The detailed evaluation of the long-term (3rd order) Aptian sea-level cycle results in the recognition of sea-level and climate as controlling factors on depositional environments in the basin. The rising part of the Aptian sea-level cycle lasted from the *Deshayesites tenuicostatusis* Zone to the *Deshayesites deshayesi* Zone, and transgression is responsible for the local development of anoxia on the Eastern Russian Platform. The Lower Aptian bituminous shales and sheeted calcite concretions associated with the Eastern Russian Platform are interpreted as being a regional manifestation of Oceanic Anoxic Event OAE 1a. The Late Aptian "cold snap" that occurred during the Early Cretaceous greenhouse world coincided with a simultaneous global and regional sea-level lowstand, peak shallowing of the basin, and the almost complete absence of sediments due to subaerial exposure in the studied region. The global distribution of the lowstand gives clear evidence for sea-level fluctuations, and intrinsic climate control on sequences in the study area.

1. Introduction

Sea-level fluctuations and the reconstruction of climate changes are important issues that need to be addressed in the identification of controls on the evolution of marine sedimentary basins. In this respect, a number of recent publications have provided relevant information on genetic relationships between lithology of Cretaceous marine sedimentary strata, depositional environments, volcanic activity, and sea-level and climatic changes (e.g., Schlanger and Jenkyns, 1976; Yilmaz and Altiner, 2006; van Breugel et al., 2007; Robinson et al., 2008; Méhay et al., 2009; Millán et al., 2009; Wagreich et al., 2009; Karakitsios et al., 2010; Keller et al., 2011; Hay and Floegel, 2012; Hu et al., 2012; Elkhazri et al., 2013; Maurer et al., 2013).

Similar studies have been carried out on the Russian Platform, albeit to a limited extent. Thus, numerous eustatic and tectonic signals have been defined in Cretaceous sediments of the Russian Platform from a considerable amount of data available from well and outcrop studies (Naidin, 1995). Consequently, Sahagian and Jones (1993), Sahagian et al. (1996) developed the regional sea-level curve for the Central part of the Russian Platform on the basis of facies changes and interpreted bathymetric models.

Gavrilov et al. (2002) further indicated that the anoxic depositional environments in Aptian strata of the Russian Platform correlates with the global Oceanic Anoxic Event OAE 1a, and they proposed a controlling mechanism of Aptian carbonaceous sedimentation. Paleotemperatures during the late Barremian–early Aptian on the Russian Platform have been determined on the basis of oxygen isotope analyses (Zakharov et al., 2013). Reliable chronostratigraphic analyses of selected sections, and further regional-scale investigations on tectono-eustatic and progradation–retrogradation cyclicity, transgressive–regressive regime, regional sea-level and climate changes have also been carried out on Jurassic and Cretaceous series of the Eastern Russian Platform (Zorina et al., 2008; Zorina, 2009, 2012, 2013, 2014a,b,c; Zorina and Ruban, 2012).

In the present study, a new detailed Barremian–Albian regional sea-level curve is presented for the Eastern part of the Russian Platform. Using the previously proposed method of comparison of the global sea-level curve with the regional sea-level curve (Zorina, 2014a), the 3rd order Aptian sea-level cycle is reconstructed in detail, resulting in the interpretation of sea-level and climatic controls on depositional environments. Widely discussed causes and consequences of the Late Aptian "cold snap" and Oceanic Anoxic Event 1a (e.g. Bottini et al., 2015; Moullade et al., 2015) are also considered.

The major forcing mechanisms associated with OAEs are an abrupt rise in temperature (Read, 1995, 1998), a decrease in dissolved oxygen in the water (Schlanger and Jenkyns, 1976), a significant increase in the oceanic productivity (Leckie et al., 2002), and a decrease of the global ocean circulation probably caused by large-scale Pacific volcanism during the formation of the Ontong Java Plateau, the Manihiki Plateau, and the Nova-Canton Trough (Larson and Erba, 1999; Erba and Tremolada, 2004; Méhay et al., 2009; Tejada et al., 2009; Jenkyns, 2010; Keller

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